2004 Funded Projects - *Monday, August 23, 2004 at 14:49*

Production Agriculture Projects

Accelerated Development of Solid-Stemmed Wheat Varieties (Montana State University, Bozeman)

Wheat varieties with solid stems are resistant to damage caused by the wheat stem sawfly. Recent research funded by the Montana Board of Research and Commercialization Technology allowed MSU researchers to develop molecular markers for the major gene causing solid stems in wheat. The aim of this proposal is to use these markers to rapidly cross the solid stem trait into a set of spring and winter wheat varieties adapted to all areas of Montana. The goal of the work is to produce sawfly resistant wheat varieties that yield as well as susceptible varieties, leading to improved profitability of wheat production in the sawfly-infested areas of Montana.

Development of Montina™ Value-Added Gluten-Free Cereal and Snack Food Products Through Extrusion Technology (Montana State University Institute for Bio Based Products & Food Science, Kalispell/Bozeman)

The Amazing Grains Cooperative of Ronan, Montana and Montana State University researchers will be developing new ready-to-eat, gluten-free breakfast cereals and snack foods from Montina gluten-free flours. The project will involve several cereals, which have been tested and found gluten free. Several of these cereals are native to the Great Plains and were dietary staples of Native American tribes for centuries prior to the introduction of other cereal crops. The market potential of Montina gluten-free products is considerable. A small but significant percentage of the population in the United States (1 person per 133 Americans) suffers from Celiac disease, or some form of gluten intolerance. The only remedy for this disease is to avoid foods that contain wheat, barley, rye and other grain products containing the gluten protein or related proteins. These new gluten-free breakfast cereals and snack foods will be a welcome addition to a market where flavorful and convenient products are often difficult to find. One unique feature will be a gluten analysis on each package of product stating the gluten analysis of its contents. This will provide consumers with a quality assurance they have previously lacked. There is also a robust market for these products from people who do not suffer Celiac disease but would like to consume unique food products such as Montina.

Biological Treatment of Animal Wastes by Endophytic Fungi and "Mycofumigation" (Montana State University, Bozeman)

The primary aim of this project is to determine if the volatile gases of the endophytic fungus *Muscodor albus* and other added endophytic microbes are a safe, effective biological means to reduce or eliminate the harmful

organisms in animal wastes to reduce waste volume, and reduce waste odors. The goal is to make wastes more readily recyclable with the least impact on the environment. It turns out that microbes in animal wastes pose a threat to human health, and are detrimental to the water and land associated with such wastes. This project seeks to develop a novel product that would expand the sales base of Phillips Environmental Products, Inc. (Phillips). The project will explore the proper conditions for the addition of *M. albus* or one of its related species to treat animal wastes to ameliorate waste gases, waste microbes and waste dry matter. The discovery and ultimate addition of other waste degrading fungi that are compatible with the gas producers are other project aims. Already this approach has met with success at Phillips as they are in the process of using the fungi *M. albus* and *Fusarium* sp to treat human urine and solid wastes in their biodegradable bags (Wag Bags) sold in conjunction with their PETT system on a worldwide basis. The value of an effective animal waste treatment system to the world is enormous. Furthermore, since an effective biological system has been worked out for human waste treatment, there is a very good chance for an effective system to be developed for animal waste application using the novel endophytic microbe -*M. albus.*

Value-Added Crops for Irrigated and Dryland Production in Montana (Eastern Ag Research Center, Montana State University, Sidney/Bozeman)

This project will develop and enhance value-added qualities in crops that are currently grown under irrigated and dryland production in eastern Montana, through varietal improvement, management practices, and identity preservation. Development of high quality durum varieties tailored for the warmer, semi-arid conditions of this region will give durum producers a competitive edge in durum production and will allow further expansion of the semolina and pasta industry into Montana. Durum varieties with modified starch may result in development of products for the health food market. Malt barley acreage is rapidly increasing in eastern Montana. High yielding varieties with short, stiff straw are needed for irrigated acres to compete with spring wheat, while varieties with low protein are needed for acceptable malt quality when grown under dryland conditions. Development of barley for ethanol production could attract building of ethanol production plants in the area. Hard white wheat is a potential crop for irrigated and dryland production. Development of best management practices for highest quality white wheat is needed to attract buyers and processors. High oleic/low saturate varieties of safflower will be used to produce high quality, non-GMO edible oil. High oleic safflower oil will help promote a Montana produced bio-fuel and bio-lubricant industry. High linoleic safflower varieties may be grown to provide livestock rations to improve meat quality and extend shelf life. Improved management practices for all these crops will result in more uniform, high quality crops.

Developing Improved Hay Barley Varieties for Montana (Montana State University, Bozeman)

The main objective of this project is the development of new forage barley varieties with enhanced agronomic performance and nutritional quality for livestock. Evaluating forage quality of hay barley varieties by feeding it to animals is very expensive and time consuming. Using laboratory analyses, the cost of evaluating new barley lines for forage quality characteristics is reduced and could potentially speed up the selection process. In addition to nutritional analyses, yield tests will be conducted in several locations to expose the selections to different environmental effects. Barley varieties with high forage quality, low nitrate accumulation potential, and improved agronomic characteristics will be developed. Crop and livestock production are increasingly technology-based, as producers strive to meet challenges associated with changing market demands, increased regulations, and low commodity prices. This research will provide producers with the information and technology necessary to create value-added opportunities in Montana's grain and beef industries. A key component of value-added strategies are the integration of crop and livestock systems. The development and release of modern, high-yielding varieties with increased nutritional value will allow producers to utilize on-farm production in cattle feeding and back-grounding operations. Development of new forage barley varieties will not only improve quality of forage fed to beef cattle, but will benefit barley producers through improved agronomic traits such as increased yield.

Development of Invaplex as an *In Vitro* Transfection Reagent (LigoCyte Pharmaceuticals, Bozeman)

LigoCyte Pharmaceuticals will be applying its expertise in molecular biology to develop the novel research reagent, LPTR. LPTR induces uptake of genetic material (DNA, RNA) by cells in culture, a process known as transfection. This technology allows researchers to study cells at the genetic level and thereby gain insight into the highly complex processes that govern their function. The reagents currently available to the scientific community suffer from several shortcomings. The objective of this project is thus to develop a dependable and consistent transfection reagent with widespread applicability. The existing market for such a product is substantial, encompassing a large part of the molecular and cellular biology research community. Funding provided by the Montana Board of Research and Commercialization Technology will be used to evaluate the efficacy of LPTR. The project follows an aggressive time line, with research and development to be completed in two years.

Biologically-Based Products for Management of the Wheat Stem Sawfly (Montana State University, Bozeman)

The wheat stem sawfly is the most destructive insect pest of wheat in Montana. It cannot be controlled with traditional methods such as insecticide application or tillage; therefore new management strategies are needed.

This project investigates the feasibility of rearing effective strains of native parasitoids that can be made available for release in sawfly-infested fields. Next, the pheromone chemicals produced by sawflies will be tested to determine if they can be used to disrupt mating behavior. Finally, this project will study naturally occurring endophytes that kill sawfly larvae in wheat stems. Success in these research areas will lead to products that can be commercialized.

Functional Analysis of Genes Controlling Malting Barley Grain Protein Concentration (Montana State University, Bozeman)

Mature cereal grains (such as those from wheat and barley) are mostly composed of starch (typically greater than 60 percent of their weight) and storage proteins (typically between 10 and 20 percent of their weight). Depending on their use, the exact composition is an important quality factor. Grain protein is especially important for malting barley, as high protein is associated with the formation of undesirable precipitates (sediment) in beer. Therefore, research performed in this project will focus on the identification of biological processes controlling grain protein concentration in mature barley grains. Knowledge gained through this project will be utilized over the next few years for the development of improved barley varieties. It is likely that malting barley will become a more important source of revenue for Montana farmers, due to the construction of a new malting barley plant in Great Falls.

Other Projects

Development of a Novel Tissue Valve for Replacement of Diseased Aortic, Pulmonary and Vein Valves (International Heart Institute of Montana, Missoula)

To maintain forward blood flow, the circulatory system has many one-way valves. Several of these are often diseased. The most frequently diseased are the aortic and pulmonary heart valves and the vein valves in the lower extremities. Treatment of the malfunctioning heart valves requires open-heart surgery where, under direct vision, the valve is replaced with prosthesis. No prosthesis is available for vein valve replacement.
The aim of the project is to develop a valve made of animal tissue that can be collapsed inside a metallic mesh stent and placed within a delivery balloon catheter. The device is then introduced through a peripheral vessel and directed under radiologic control to the desired position, where the valve and stent are expanded. The catheter is then removed. This "percutaneous" technique avoids the need to open the patient's chest and the use of cardiopulmonary bypass. Preliminary studies have resulted in an original valve design and a chemical treatment of the tissue to avoid rejection. The Montana Board of Research and Commercialization Technology grant will bring these prototypes to a product for use in patients. Thus far, no such valve is commercially available.

Optical Coherent Transient RF Signals Processors for Pulse Shaping and Arbitrary Waveform Generation (Montana State University, Bozeman)

Optical coherent transient processing is a photonic technology that utilizes the ability of certain optical crystals to be programmed to create arbitrary ultra-high speed patterns or to precisely delay and filter hundreds of unknown complex radio frequency signals simultaneously in a single crystal the size of a sugar cube. Fortunately, the world's best grower of these unique crystals is a company in Bozeman. The Montana Board of Research and Commercialization Technology award matches an Air Force grant that develops optical methods for performing complex radar signal processing in these crystals. The researchers at Montana State University have extensive expertise on optical coherent transient processing and RF photonics. The proposed research brings together and builds on expertise in optical coherent transients, materials growth and characterization, physics, processing techniques, and system analysis to concentrate on developing high technology products that are unique to Montana.

Research Support for the Manufacturing and Marketing of the Drip Flow Biofilm Reactor (Montana State University, Bozeman)

The Center for Biofilm Engineering, in collaboration with the Montana company, BioSurface Technologies, Inc., received funding to develop a biofilm growth reactor into a commercial product. Biofilm consists of bacteria attached to a surface embedded in a layer of slime. Biofilm growth is found in extremely diverse environments including medical implants, drinking water distribution pipes and hot tub filters. In all three cases, the goal is to control and/or eliminate the biofilm. Before a company develops and markets an anti-biofilm product, it must first verify the product's efficacy in the laboratory. Applied biofilm research requires that methods and associated reactor systems be designed and/or modified to incorporate the defining parameters for each environment where biofilm exists. This project will focus on the development of the drip flow biofilm reactor and associated operating protocol. The final product will enable researchers to study biofilm grown under low flow conditions, close to the air/liquid interface.

Optimizing KTP Waveguide Performance for Precise Optical Characteristics (AdvR, Inc., Bozeman)

A long-range objective of AdvR, Inc. is to commercialize waveguide technologies based on a nonlinear optical material called potassium titanyl phosphate (KTP). Like an optical fiber, KTP waveguides are used to confine a beam of laser light. Unlike optical fibers, however, KTP has unique material characteristics that allow the properties of the confined laser beam to be significantly modified. For example, using a particular KTP waveguide structure, a red laser beam can be converted into a blue laser beam as it propagates down the waveguide. AdvR, Inc. is emerging as a leader in KTP

waveguide design and fabrication. However, the current state of the art for waveguide fabrication in KTP does not allow sufficient control of the waveguide's optical characteristics required for several important commercial applications. AdvR will use the Montana Board of Research and Commercialization Technology funding in conjunction with funding from a Navy SBIR grant and a National Science Foundation SBIR grant to significantly advance the current waveguide fabrication technology, thus enabling production of commercially useful waveguides in KTP. KTP waveguides have a broad range of potential uses in fields that include laser wavelength conversion, laser frequency stabilization, spectroscopy and optical telecommunications.

Advanced Materials for Metal Processing, Recovery and Remediation (University of Montana, Missoula)

The research group of Professor Edward Rosenberg in the Department of Chemistry has an ongoing collaboration with a local company, Purity Systems Inc. (PSI). The company's goal is to develop new solid phase adsorbent materials for the removal of toxic metals from industrial and mining waste streams and to provide more environmentally benign methods for processing valuable metal ores. Professor Rosenberg and his coworkers have been working on the project for more than ten years, resulting in three patents held by The University of Montana. PSI has the exclusive license to practice the technology worldwide. There has been considerable interest expressed by the mining industry in employing this new technology and PSI is currently arranging for large scale manufacturing of materials in China. An Australian mining testing company, Ammtec Ltd., is currently testing and marketing the products developed so far and is expected to invest in PSI in 2004. Ongoing research in the Rosenberg group is aimed at meeting the demands of the mining industry and at developing new processes and materials with improved performance and a broader applications base. PSI, the National Science Foundation's SBIR program and the Montana Board of Research and Commercialization Technology sponsor the research.

Ultra Short Laser Pulse Autocorrelator Based on Two-Photon Absorbing Chromophores (Montana State University, Bozeman)

This project will develop novel instrumentation for the detection of very short pulses of light produced by state-of-the-art ultra fast laser systems. Ultra fast lasers are rapidly emerging as efficient tools in various areas ranging from materials processing to medicine. The new instrument, called an auto-correlator, is essential for the proper
control of these lasers. This work will be performed in collaboration with the Scientific Materials Corp. of Bozeman, and will utilize special materials patented earlier by scientists at MSU.

Development of New Products for the Field Detection of Bioterrorism Pathogens (Montana State University, Bozeman)

Dr. Brenda Spangler and SensoPath Technologies, Inc. of Bozeman are developing a kit designed for use by first responders (police, firefighters, paramedics and other emergency response teams) for rapid detection of bioterror pathogens at the point of attack. A new type of biosensor is proposed which uses antibodies directed against toxins released by the bioterror pathogens. The antibodies are tagged with a very bright fluorescent molecule and assembled in easy-to-use kit form for deployment in the field by relatively untrained personnel. At the point of attack, the tagged antibodies can be mixed with a sample and analyzed using a rapid, easy separation method to determine whether the pathogen is present. Multiple pathogen detection is possible by supplying antibodies to a range of pathogens identified as potential bioterror threats. At the current time, no commercial products are available that can identify bioterror pathogens at the point of attack in less than four hours. In order to maximize marketing and sales efforts, a fully functioning kit for demonstration purposes to potential customers, especially first responder groups such as police, firefighters, paramedics and emergency rooms will be designed.

Montana Infrastructure via Science and Technology Enhanced Partnerships INSTEP (University of Montana/Missoula and Montana State University/Bozeman)

The Experimental Program to Stimulate Competitive Research (EPSCoR) is a joint program of the National Science Foundation (NSF) and numerous states. It is designed to promote the development of science and technology resources in these states. The Montana NSF EPSCoR program, which is collaboratively run by The University of Montana-Missoula and Montana State University-Bozeman, has been awarded $3 million in funding from the Montana Board of Research and Commercialization Technology (MBRCT) to be spent during fiscal years 2004 and 2005. This funding will be matched with a NSF proposal that is requesting $9 million in federal dollars (2004-2007) for the continued growth and development of academic and corporate partnerships. Building upon the present success of the joint NSF and MBRCT awards ($13.5 million for 2001-2004) in biomolecular structure and function, nanotechnology and integrated analysis of complex biological systems, UM and MSU will continue to build infrastructure in nanotechnology and begin growth in three new focus areas: bioengineering, biomolecular structure and dynamics and neuroscience. As these areas grow, they will promote the expansion of Montana's science and technology resources due to partnerships involving the state's universities, industry and government through federal research and development enterprises. Montana NSF EPSCoR operates on the principle that aiding researchers and institutions in securing federal funding will promote and further advance the State’s research infrastructure and economic growth. These advances will assist in maximizing the potential inherent in Montana’s science and technology resources and their use as a robust foundation for economic investment.

Deployment of a Real-Time Coal Content/Ore Grade Sensor (Resonon, Inc., Bozeman)

The coal content/ore grade sensor is a machine vision system based on a technology known as hyperspectral imaging or spectral imaging. Much like a digital color camera, hyperspectral data provides a numerical value for the amount of each color within a scene. The key difference between a digital color camera and hyperspectral imager is that a digital camera sees only three colors (red, green, and blue), whereas the Resonon instrument sees over 200 colors in the visible and near infrared spectral regions. With these extra color channels, very slight changes in colors can be distinguished using sophisticated software developed by the remote sensing community. The purpose of this effort is to use these capabilities to distinguish between ore grades, thereby simulating the trained eye of a geologist. This will allow for more efficient sorting of ores and ultimately selective mining, thereby increasing mining productivity, improving mine safety, and decreasing environmental impacts. Other possible applications for this technology include precision agriculture, biomedical research, and environmental monitoring.

Two-Photon Volumetric Re-Writable Optical Memory Material (Montana State University, Bozeman)

The goal of this project is to supply a novel light-sensitive compound for emerging ultra-high capacity (Terabyte) computer data storage technology. The project takes advantage of greatly enhanced multi-photon efficiency of proprietary organic compounds recently developed at MSU in collaboration with a local company, MPA Technologies, Inc. (MPAT). This novel class of light-sensitive compounds allows researchers to surpass all currently used digital storage materials by a wide margin. This work will be performed in collaboration with MPAT.